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DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

10/031655INTERNATIONAL APPLICATION NO.
PCT/EP00/04153INTERNATIONAL FILING DATE
10 May 2000 (10.5.00)PRIORITY DATE CLAIMED
10 May 1999 (10.05.99)

TITLE OF INVENTION

**METHOD AND DEVICE FOR FASTENING AN AUXILIARY JOINING ELEMENT TO A SHEET-SHAPED WORK
PIECE AND WORK PIECE THAT IS PROVIDED WITH SUCH AN AUXILIARY JOINING ELEMENT**

APPLICANT(S) FOR DO/EO/US

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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☒ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter 2 and 35 U.S.C. 1.821 - 1.825
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information:

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.101) 10/031655		INTERNATIONAL APPLICATION NO. PCT/EP00/04153		ATTORNEY'S DOCKET NUMBER 60174-024	
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24. The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input checked="" type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 <div style="text-align: right; margin-top: 5px;">ENTER APPROPRIATE BASIC FEE AMOUNT =</div>				CALCULATIONS PTO USE ONLY	
				\$1,040.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	18 - 20 =	0	x \$18 00	\$0.00	
Independent claims	3 - 3 =	0	x \$84.00	\$0.00	
Multiple Dependent Claims (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$1,040.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$1,040.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (i)).				\$0.00	
TOTAL NATIONAL FEE =				\$1,040.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL FEES ENCLOSED =				\$1,040.00	
				Amount to be: refunded	\$
				charged	\$

a. ☒ A check in the amount of **\$1,040.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **08-2789**. A duplicate copy of this sheet is enclosed.


d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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5 Method and apparatus for the fastening of an auxiliary joining element to a sheet-metal-like work-piece and work-piece having an auxiliary joining element

10 The invention relates to a method of fastening an auxiliary joining element to a sheet-metal-like work-piece in which a foot of the auxiliary joining element is pressed from one side into the work-piece and deforms this in pot-like manner. Furthermore, the invention relates to an apparatus for the fastening of an auxiliary joining element to a sheet-metal-like work-piece having a die which has a recess and having a holder for the auxiliary joining element which is arranged in alignment with the recess and can be moved in a pressing direction relative to the die. Finally the invention
15 relates to a work-piece having an auxiliary joining element in which the work-piece has an outwardly directed projection into which a foot of the auxiliary joining element projects.

20 The term "sheet-metal-like work-piece" in connection with the present invention not only means a piece of sheet metal but rather work-pieces which are formed, at least in the region of the auxiliary joining element in plate-like manner with a relatively small wall thickness, with the material of the work-piece being capable of being deformed to an adequate degree. In addition to pieces of sheet-metal plastic panels also fall under the term
25 of a sheet-metal-like work-piece.

In some cases it is necessary to connect an auxiliary joining element with the work-piece in order, with the aid of the auxiliary joining element, to be

able to attach third elements to the work-piece. Auxiliary joining elements can for example be threaded bolts which have an external thread onto which a nut having a thread can be screwed. Auxiliary joining elements can also have an internal thread into which a bolt can be screwed. This listing is however not exclusive. Auxiliary joining elements are required in large numbers in motor vehicles and domestic appliances for the attachment and holding of trim panels and conducting lines. Grooving or roughness on their surface is frequently sufficient for the attachment of other parts.

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Such auxiliary joining element having the advantage that they can be connected to the work-piece without the supply of heat being necessary for this purpose, as is the case with welding or soldering for example. Other aids, such as adhesives are not necessary. Accordingly the connection of the auxiliary joining element to the work-piece by forming is always of advantage when different materials are used for the work-piece and the auxiliary joining element which cannot otherwise be connected without further ado.

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In the simplest case the auxiliary joining element is pressed into the work-piece and deforms the latter in such a way that it has, at the side opposite to the auxiliary joining element, a pot-like or beaker-like outwardly directed projection. This auxiliary joining element is then clampingly held in the work-piece. A connection of this kind has indeed in most cases adequate shear strength. The resistance against head pull-out and the security against rotation are however restricted.

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DE 30 03 908 A1 shows a stud having piercing and riveting behaviour. This stud produces an opening by piercing on being inserted. The slug which results is retained in a recess at the underside of the stud. The peripheral wall of this recess is bent radially outwardly towards the end of the piercing process and then engages around a likewise bent-over edge of the work-piece which has arisen during the piercing process.

DE 22 44 945 A1 shows a method for the mechanical connection of sleeve-like parts with plate-like parts in which the plate-like part must be pierced prior to the introduction of the sleeve-like part. The sleeve-like part has in this respect various "feet" which have to be bent outwardly after insertion.

DE 196 47 831 A1 shows a method for the attachment of a functional element, for example a stud, to a sheet-metal work-piece in which the foot of the stud has projections and recesses through which undercuts of the work-piece form with the foot of the stud during the insertion.

The invention is based on the object of securing an auxiliary joining element which can be loaded in several directions to a work-piece in a simple manner.

This object is satisfied in a method of the initially named kind in that the foot forms an undercut with the work-piece and the undercut is restricted to predetermined peripheral regions.

With this manner of proceeding one not only presses the auxiliary joining element into the work-piece, with the work-piece being deformed. The auxiliary joining element is also deformed in this way at its foot. The foot

is deformed at least partially radially outwardly in relation to the peripheral direction and thereby forms an undercut to the work-piece, which is likewise deformed radially outwardly in these regions. "Radial" here relates to the main axis of the auxiliary joining element, for example its thread axis. With this design one achieves on the one hand an improved strength against head pull-out. The auxiliary joining element is secured more strongly against being pulled-out of the work-piece. As a result of the interrupted undercut in the peripheral direction care it is also ensured that the auxiliary joining element is secured in the work-piece against rotation. Thus, the screwing on of nuts or the screwing of bolts into the auxiliary joining element is such screw connections can be pulled tight with a relatively high torque. Finally this design has the advantage that one obtains a connection between the auxiliary joining element and the work-piece in which the auxiliary joining elements and the work-piece contact one another with a relatively high pressure, in particular of the region of the undercuts. This pressure remains even after completion of the connection. This is in particular favourable when an electrical current is to be transferred via the auxiliary joining element to the work-piece, for example, when the auxiliary joining element is used as a ground connection bolt in the sheet metal of a vehicle body.

Preferably one allows material to flow from regions without undercut into regions with undercut. For the manufacture of the undercut regions there is now more material available. One can, in other words, now concentrate the material which is normally available at the entire periphery of the pot-like outwardly deformed projection into a few undercut regions. Thus it is possible, with the same quantity of material, to allow the undercut to project further or deeper perpendicular to the pressing direction. One has

found that the strength of the connection is dependent to a stronger degree on the depth of the undercuts than it is on the length in the peripheral direction. Thus, if one restricts the undercuts to regions in the peripheral direction these regions can be designed with greater overlap in the undercut region and the connection as a whole is then stronger and indeed both with respect to the head pull-out strength and also with respect to the security against rotation.

One preferably produces wall sections which extend parallel to the pressing direction at the outer side of the work-piece which lies opposite to the auxiliary joining element. This design have several advantages. On the one hand the demolding, i.e. the extraction of the work-piece provided with the auxiliary joining element out of the corresponding apparatus, for example out of a die, is relatively simple. In the regions where the outer side extends parallel to the pressing direction one then no longer has to perform any deformation work in order to remove the work-piece. It is only necessary to overcome the adhesive friction forces. On the other hand, one can, particularly with at least approximately vertical peripheral walls, ensure that ideal flow paths into the undercut regions are present for the two materials of the work-piece and the auxiliary joining part.

One advantageously produces a closing force on at least one tool part when pressing via the work-piece and an opening force on the tool part which is arranged in the region of an undercut on extracting the unit formed by the work-piece and the auxiliary joining element. The method is thus quasi self-controlling. In the region of the recess there is located a tool part which is so formed that an undercut arises when the material of the work-piece is pressed in there. Since this tool part is held by the work-

piece in its closed position the tool part cannot open. The situation is however different when the work-piece is extracted from the tool. In this case the pressure on the tool part drops away. This can then open and releases the work-piece. For the opening a very small force is required.

- 5 During the open process no reverse deformation can accordingly be brought about.

- 10 Preferably three or more undercut peripheral regions are produced. In this way a connection can be achieved which is supported on all sides perpendicular to the tensile force. The more undercut regions that are present the better is the security against rotation.

- 15 One preferably applies the pressure to the auxiliary joining element at an auxiliary shoulder. This is in particular of advantage when the auxiliary joining element is provided with a thread. The auxiliary shoulder is then so positioned that the thread is not compressed, or deformed in another manner, when applying the pressure.

- 20 The auxiliary shoulder is preferably arranged adjacent to the work-piece. Thus only a very short length of the auxiliary joining element is available in which the auxiliary joining element can be deformed. In the remaining length a region can then be provided which receives the thread, which in this embodiment can, intentionally, no longer be deformed.

- 25 In a preferred embodiment provision is made that at least one further sheet-metal-like work-piece is arranged between the work-piece and the auxiliary joining element and is likewise of a pot-like shape with undercuts restricted in the peripheral direction. One can simultaneously use the

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With a joining apparatus of this kind one first of all obtains a relatively simple layout of the die. Through the use of levers or fingers which can be brought into their working position and held there by the pressing process itself one saves auxiliary aids such as springs or other pre-stressing means which are required in order to place the die in the closed state, which one requires in order to be able to start the deformation at all. The levers move into their working position at the instant where the tool is pressed onto the die and is subjected to pressure via the auxiliary joining

element; they are thus moved radially inwardly, i.e. pivoted and then make available undercut regions. They cannot move out of this working position and indeed also not under the pressure of the inflowing material because they are held in the working position by the work-piece itself. The

5 undercuts formed by the levers now make a space available into which the material of the work-piece and of the foot of the auxiliary joining element can flow. In this connection one can assume that not only the material of the work-piece flows into the undercut region, but rather also the material of the foot of the auxiliary joining element, so that the auxiliary joining

10 element forms an undercut with the work-piece in the sense of a form-fitted hooked engagement. With an undercut of this kind, which can also be recognized at the die side, the extraction of the work-piece from the die would normally signify a certain problem. In accordance with the invention this problem does not however arise because on lifting the work-piece

15 the corresponding lever is moved outwardly, i.e. pivoted, so that it can enter into the release position where it fully releases the work-piece. In this connection the lever only has to overcome small spring forces, so that the extraction of the work-piece can take place with relatively little effort. The fact that, on removing the work-piece from the die, the levers do not

20 stretch the underside of the work-piece under pressure, so that corresponding tracks can be largely avoided, comes as a further advantage. This not only protects the work-piece but rather also the corresponding contact surfaces on the levers.

25 The levers preferably have a substantially planar top side which in the working position stand perpendicular to the pressing direction and lies in the same plane as the top side of the die. Thus the pressing force acts in such a way that the levers are only loaded in the closing direction. The

levers do not have to bear any lateral forces. Because the work-piece, so to say, sees an oppositely continuous and planar surface, if one ignores the recess, then no markings arise in the surface of the work-piece outside of the connection zone. Pressure peaks on the levers can be avoided. The loading takes places relatively uniformly in the working position so that the levers are protected and accordingly have a relatively long working life.

Each lever is preferably formed as a cranked lever. The pressing force which is used for the movement of the levers into the working position and for the holding of the levers can then act on a larger area. The lever transmission ratios are more favourable here so that one can also bear the required forces with a relatively weakly dimensioned lever.

In a preferred manner the cranked lever has a short arm on which the wall section is arranged and a long arm at which a pivot axis or a pivot region is located. The lever is thus formed in the manner of an upside-down L, can however also have further projections or recesses. The wall section which forms a part of the side-wall of the recess of the die and thus the undercut regions is located at the end face of the short limb. The forces which act here are passed on by a relatively long lever arm to the pivot axis or to the pivot region. The term "pivot region" gives expression to the fact that the pivot axis can move along the lever. If one now allows the closing forces to act via a similarly long lever arm, i.e. on the outer side of the short limb of the "L" then a good force equilibrium occurs with a relatively small degree of cost and complexity.

In an alternative embodiment the lever has an outer side which includes an acute angle with the pressing direction and is guided on a correspond-

20 The plunger preferably has a recess into which a shaft of the auxiliary joining part projects and which is surrounded by a pressure surface, with the auxiliary joining element having an auxiliary shoulder which lies on the pressing surface. In this way one can achieve a situation in which the auxiliary joining element is admissibly guided by the plunger. The loading
25 can however be restricted to regions of the auxiliary joining element which lie outside of the guide and thus of the plunger. An impermissible deformation of the auxiliary joining element is avoided in this way, particularly when using threads on the auxiliary joining element.

The object is satisfied by a work-piece with an auxiliary joining element in that the foot forms an undercut with the work-piece and the undercut is restricted in the peripheral direction to predetermined peripheral regions.

5 In this way one can achieve a situation in which a relatively high security against rotation is achieved. In addition the depth of the undercut, i.e. the depth of the form-locked hooked arrangement, can be made relatively large. The material required for this can originate from the regions in which no undercut is present. The flow characteristics, and also the combination of the auxiliary joining element and the work-piece can be optimized through the forming at the active surfaces of the levers forming the undercut. The size and the location of the form-fitted hooked connection can be optimized and defined by the choice of the predetermined peripheral regions and the depth of the undercut.

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The invention will be described in more detail in the following with reference to preferred embodiments in conjunction with the drawing in which are shown:

20 Fig. 1 a schematic view of an apparatus for the connection of an
 auxiliary joining element to a sheet-metal-like work-piece,

Fig. 2 a plan view of a die of the apparatus of Fig. 1,

25 Fig. 3 an auxiliary joining element,

Fig. 4 another embodiment of an auxiliary joining element,

- Fig. 5 a work-piece with auxiliary joining elements secured therein,
- Fig. 6 a schematic representation of a connection of two sheet-metal-like components with the aid of auxiliary joining elements and
- Fig. 7 a representation corresponding to Fig. 1 with another auxiliary joining element,
- Fig. 8 an apparatus which has been modified relative to Fig. 1,
- Fig. 9 a view corresponding to Fig. 2, and
- Fig. 10 various stages while operating with the apparatus of Fig. 8.

Fig. 1 shows an apparatus for the connection of an auxiliary joining element 2 to a sheet-metal-like work-piece 3.

- The sheet-metal-like work-piece 3 can also be formed from sheet-metal. It can however also be a work-piece of plate-like form, at least section-wise of a plastic material which can be deformed similarly to metal sheets.

Examples for auxiliary joining elements are shown in Figs. 3 and 4 with the auxiliary joining element of Fig. 3 corresponding to that of Fig. 1.

The auxiliary joining element 3 which is shown in Fig. 3 comprises a shaft 4 with an external thread 5 and thus forms a threaded bolt. The shaft 4 is

connected to a foot 6 which has a somewhat larger diameter than the shaft 4. The difference in diameter forms an auxiliary shoulder 7. The foot 6 has a substantial cylindrical outer periphery. At its base side it has a recess 8 which facilitates a deformation, as will be later explained in conjunction with the method of the proceeding.

Fig. 4 shows an alternative embodiment of an auxiliary joining element 2' in which the same parts are provided with the same reference numerals. The shaft 4' has in this case an inner thread 5' so that the auxiliary joining element 2' forms a nut element into which a screw can be inserted in order to connect the screw to the work-piece 3.

Instead of the two illustrated auxiliary joining elements 2, 2' other auxiliary joining elements can naturally also be used so long as these have a fastening profile, for example one or more grooves and/or project out of the work-piece 3 in such a way that they still make a fastening surface available.

The apparatus 1 with which the auxiliary joining element 2 is connected to the work-piece 3 has a plunger 9 which contains a bore 10 into which the auxiliary joining element 2 can be inserted. In this arrangement the diameter of the bore 10 is matched to the outer diameter of the shaft 4 so that the auxiliary joining element 2 is received with little clearance in the plunger 9. A pressing surface 11 is arranged around the bore 10 with which the plunger 9 presses onto the auxiliary shoulder 7 of the auxiliary joining element 2. The pressing surface 11 is arranged in a recess 12 which is surrounded by a peripheral boundary 13. The plunger 9 is movable in the direction of a double arrow 14. The orientation of Fig. 1 will be

used for the subsequent explanation, i.e. the plunger 9 is movable upwardly and downwardly. The pressing direction is directed downwardly.

5 The apparatus 1 furthermore has a die 15 which is arranged in a die holder 16. The work-piece 3 can be pressed into the die 15 with the aid of hold-down members 17 which stand under the action of springs 18.

10 The die 15 has a recess 19 the basic shape of which is cylindrical. The recess 19 is thus surrounded by wall sections 20 which extend parallel to the pressing direction 14 and have a form of a cylindrical jacket surface. At the base of the recess 19 a step-like projection 21 is provided which, as will be explained further below, facilitates the flowing of the material during the connection of the auxiliary joining element 2 and the work-

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The cylindrical outer wall 20 is interrupted by levers 22. One such lever is shown in its working position in Fig. 1. In this position its upper side 33 lies flush with the upper side of the die 15.

20 The lever 22 has the shape of an inverted L with a short limb 23 and a long limb 24. In the working position it lies with both limbs in contact with the die 15, i.e. it is completely supported.

25 The short limb 23 forms with its end face 25 a part of the peripheral wall of the recess 19. In the working position this end face 25 is inclined, i.e. opens downwardly somewhat so that the material of the work-piece 3 can flow into the free space 26 which is formed by the inclined end face 25 of the lever 22.

way the work-piece 3 is deformed. In the sections of the recess 19 which are restricted by the cylinder wall 20 a beaker-like or pot-like outwardly directed projection is produced. As a result of the inclined end face 25 of the lever 22 a part of the material however also flows into the free space
5 26 and thus forms undercuts 29, as can be seen in Fig. 5.

With this deformation process the foot 6 with the auxiliary joining element 2 is also deformed. In the region of the undercuts 29 the foot 6 forms undercuts 30 with the work-piece 3. This deformation is assisted by the
10 projection 21, which presses the material of the work-piece 3 into the recess of the foot 6 of the auxiliary joining element 2 and ensures, on continuation of the connection process, that the material of the foot 6 forms the undercuts 30.

15 Since the plunger 9 only acts on the auxiliary shoulder 7 of the auxiliary joining element 2 the thread 5 is not deformed. The pressing movement ceases when the peripherally extending wall 13 of the plunger 9 comes into contact with the work-piece 3.

20 Since the undercuts 29, 30 are not continuous in the peripheral direction, but rather interrupted, it is possible to allow material to flow from the cylindrical sections into the undercuts 29, 30, so that here the depth of undercut can be increased.

25 It can be seen from Fig. 5 that the auxiliary joining element 2' formed as a nut (Fig. 4) can be inserted into the work-piece 3 in a similar manner to the auxiliary joining element 2 formed as a bolt. In both cases the corresponding undercuts 30, 30' at the foot 6, 6' results which cooperate with

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In the right hand half of Fig. 5 it can be seen that the connection of the auxiliary joining element 2' formed as a nut forms an additional advantage. A sealed connection namely results between the nut and the workpiece 3, so that no additional measures are necessary for a seal.

Fig. 6 shows a connection of the auxiliary joining elements 2, 2' corresponding to the illustrations of Fig. 5 with not only one work-piece 3 but rather with two work-pieces 3a, 3b. These work-pieces are held by a through clinched connection, with the auxiliary joining element 2, 2' remaining as a "lost plunger" in the work-pieces 3a, 3b. The work-pieces 3a, 3b are connected together with a relatively high head pull-out strength and shear strength. The auxiliary joining element 2, 2' is reliably held.

towards the plunger 9. Accordingly the lever 22' is moved radially outwardly when it is lifted. This movement is restricted by a ring 35 which is arranged beneath the projection and which is contacted by a lever projection 36 at the lower end of the lever 22' when the lever 22' has been drawn out upwardly by a sufficient amount. This should be explained with reference to Fig. 10. Fig. 10A shows the situation which results when the auxiliary joining element 2 has been pressed into the work-piece 3 and the corresponding undercut regions 29 have formed. The work-piece 3 presses in this arrangement onto the upper side 33 of the lever 22', so that the lever 22' is held fast in the die 15' and cannot deviate radially.

After termination of the joining process the work-piece 3 is lifted. Since the undercut region 29 basically does not pass through the opening which the levers 22' leave free at their top side, the levers 22' are lifted with it and are drawn out of the die 15' in the pressing direction (in the illustrated embodiment in a vertical direction). During this they wander radially outwardly as can be seen in Fig. 10B.

At the end of this movement the lever projection 36 comes into contact with the ring 35. These two parts thus together form a security against drop-out. The ring 35 is so positioned that at the end of the movement the opening between two oppositely disposed levers 22' is precisely so large that the undercut regions 29 can be drawn out. This can be recognized into Fig. 10c.

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Fig. 10d shows the state after the work-piece 3 has been fully drawn out. In this instant the levers 22' can drop back into the die 15' again so that

the recess 19 with the movable side walls formed by the levers 22' is again available for a new joining process.

10/031655

531 Rec'd PGT/FT. 13 NOV 2001

Claims

- 5 1. Method of fastening an auxiliary joining element (2; 2') to a sheet-metal-like work-piece (3; 3a, 3b) in which the auxiliary joining element has a foot (6; 6') which is pressed from one side into the work-piece (3; 3a, 3b) held on a die (15) having a recess (19) and deforms this work-piece in pot-like manner, characterized in that the recess
10 (19) of the die has wall sections (20) which extend parallel to the pressing direction (14) and is interrupted by the die parts (levers 22; 22') which form undercuts (26) into which the material of the foot (6; 6') and of the work-piece (3; 3a, 3b) flows and forms undercut regions (29, 30) of the foot and of the work-piece which are restricted in the
15 peripheral direction.
2. Method in accordance with claim 1, characterized in that one allows the material to flow from regions without undercut into regions with undercut (29, 30).
- 20 3. Method in accordance with claim 1 or claim 2, characterized in that one produces wall sections at the outer side of the work-piece (3; 3a, 3b) opposite to the auxiliary joining element (2; 2') which extend parallel to the direction of pressing (14).
- 25 4. Method in accordance with one of the claims 1 to 3, characterized in that, when pressing via the work-piece (3; 3a, 3b), a closing force is produced on at least one tool part (22; 22') and on withdrawing the

unit formed by the work-piece and the auxiliary joining element, an opening force is exerted on the tool part (22; 22') which is arranged in the region of an undercut (29, 30).

- 5 5. Method in accordance with one of the claims 1 to 4, characterized in that three or more undercut regions (29, 30) are produced.
6. Method in accordance with one of the claims 1 to 5, characterized in that one applies the pressure on the auxiliary joining element (2; 2')
10 at an auxiliary shoulder (7; 7').
7. Method in accordance with claim 6, characterized in that the auxiliary shoulder (7;7') is arranged adjacent to the work-piece.
- 15 8. Method in accordance with one of the claims 1 to 7, characterized in that a further sheet-metal work-piece (3b) is arranged between the work-piece (3a) and the auxiliary joining element (2; 2') which is likewise deformed in pot-like manner with undercuts restricted in the peripheral direction.
- 20 9. Apparatus for the fastening of an auxiliary joining element (2; 2') to a sheet-metal-like work-piece (3; 3a, 3b) having a die (15) which has a recess (19), and a holder (9) for the auxiliary joining element (2; 2'), the holder being arranged in alignment with the recess (19) and being
25 movable in a pressing direction (14) relative to the die, characterized in that the peripheral wall (20) of the recess (19) has movable wall sections (25) which are arranged on levers (22; 22') with the levers (22) being movable by pressure in the pressing direction (14) into a

working position and being fixable there and forming undercut re-
gions (26) and being movable by a movement of the unit comprising
work-piece (3; 3a, 3b) and auxiliary joining element (2; 2') opposite to
the pressing direction (14) into a release position in which the under-
cut regions (26) are fully released, and in that stationary wall sections
5 (20) are provided between the movable wall sections (25).

10. Apparatus in accordance with claim 9, characterized in that the
levers (22) have a substantially planar top side (33) which in the
10 working position stands perpendicular to the pressing direction (14)
and lies in the same plane as the top side of the die (19).

11. Apparatus in accordance with claim 9 or claim 10, characterized in
that each lever (22) is formed as a cranked lever (20).
15

12. Apparatus in accordance with claim 11, characterized in that the
cranked lever has a short arm (23), on which the wall section (25) is
provided and a long arm (24) at which a pivot axis or a pivot region is
located.
20

13. Apparatus in accordance with one of the claims 9 to 11, characterized
in that the lever has an outer side (27') which includes an acute angle
with the pressing direction (14) and is guided on a correspondingly
inclined counter surface (34), which extends outwardly opposite to
25 the pressing direction (14).

14. Apparatus in accordance with one of the claims 9 to 13, characterized in that at least three levers (22; 22') are arranged distributed in the peripheral direction of the recess (19).
- 5 15. Apparatus in accordance with one of the claims 9 to 14, characterized in that stationary wall sections (20) are provided between the movable wall sections (25) and extends substantially parallel to the pressing direction (14).
- 10 16. Apparatus in accordance with one of the claims 9 to 15, characterized in that the die (15) has a security (27, 28) against drop-out for each lever (22; 22').
- 15 17. Apparatus in accordance with one of the claims 9 to 16, characterized in that the plunger (9) has a recess (10) into which a shaft (4, 4') of the auxiliary joining elements (2; 2') projects and is surrounded by a pressure surface (11), with the auxiliary joining element (2; 2') having an auxiliary shoulder (7; 7') which contacts the pressing surface (11).
- 20 18. Apparatus in accordance with one of the claims 9 to 17, characterized in that the die (15) has a projection (21) at the base of the recess, which presses the material of the work-piece (3; 3a, 3b) into an outwardly directed projection (8; 8') of the foot (6; 6') of the auxiliary joining element (2; 2') and ensures that the material of the foot forms the
- 25 undercut regions (30).
19. Work-piece with an auxiliary joining element in which the work-piece (3; 3a, 3b) has an outwardly directed projection into which a foot (6;

6') of the auxiliary joining element (2; 2') projects, characterized in that the foot (6; 6') together with the work-piece (3; 3a, 3b) forms undercut regions (29, 30) which are restricted in the peripheral direction and wall sections which extend parallel to the pressing direction (14), i.e. parallel to the axial direction of the auxiliary joining element, are present on the outer side of the work-piece (3; 3a, 3b) opposite to the auxiliary joining element (2; 2') between the undercut regions (29, 30).

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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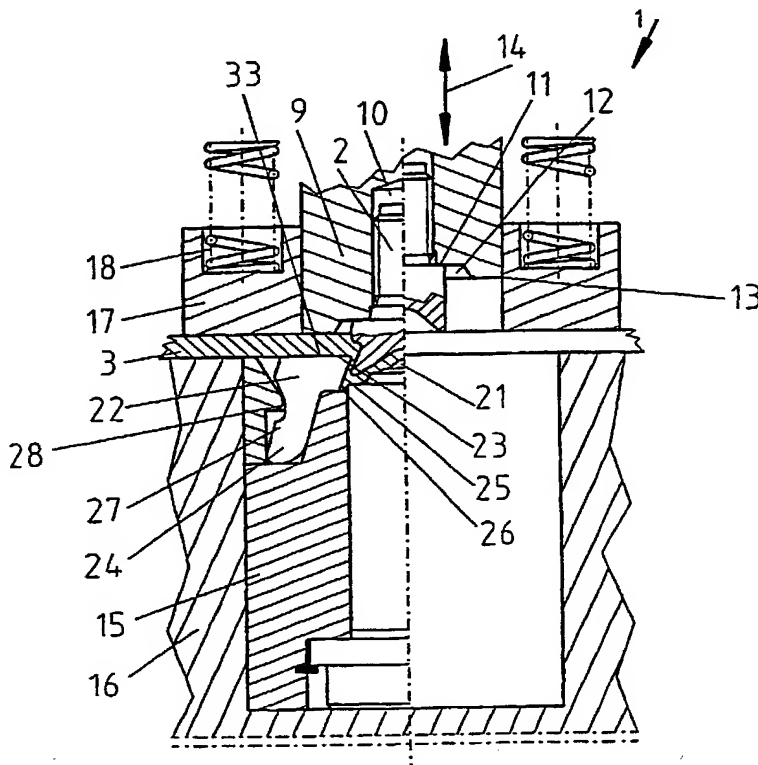
Veröffentlicht:

— Mit internationalem Recherchenbericht.

[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD AND DEVICE FOR FASTENING AN AUXILIARY JOINING ELEMENT TO A SHEET-SHAPED WORK
PIECE AND WORK PIECE THAT IS PROVIDED WITH SUCH AN AUXILIARY JOINING ELEMENT

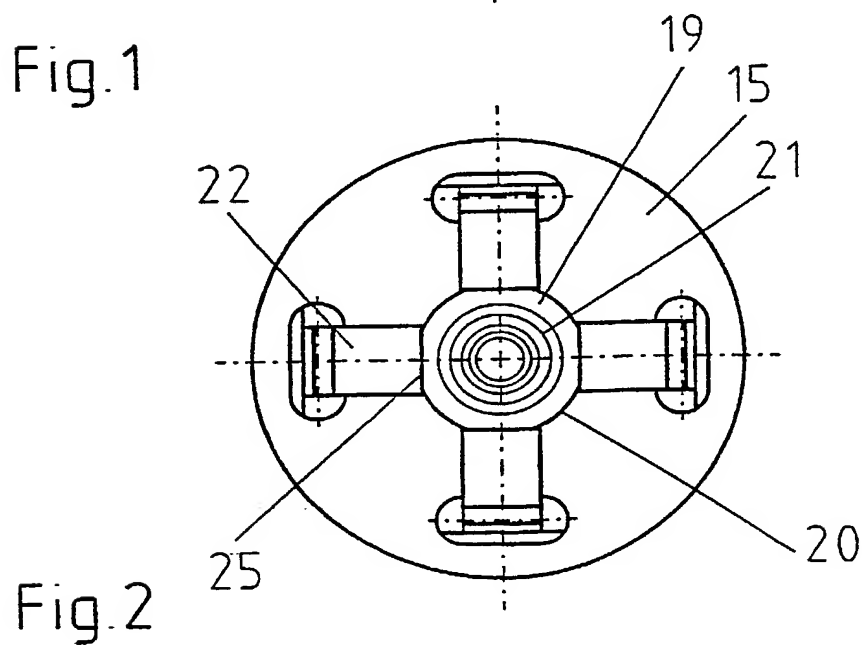
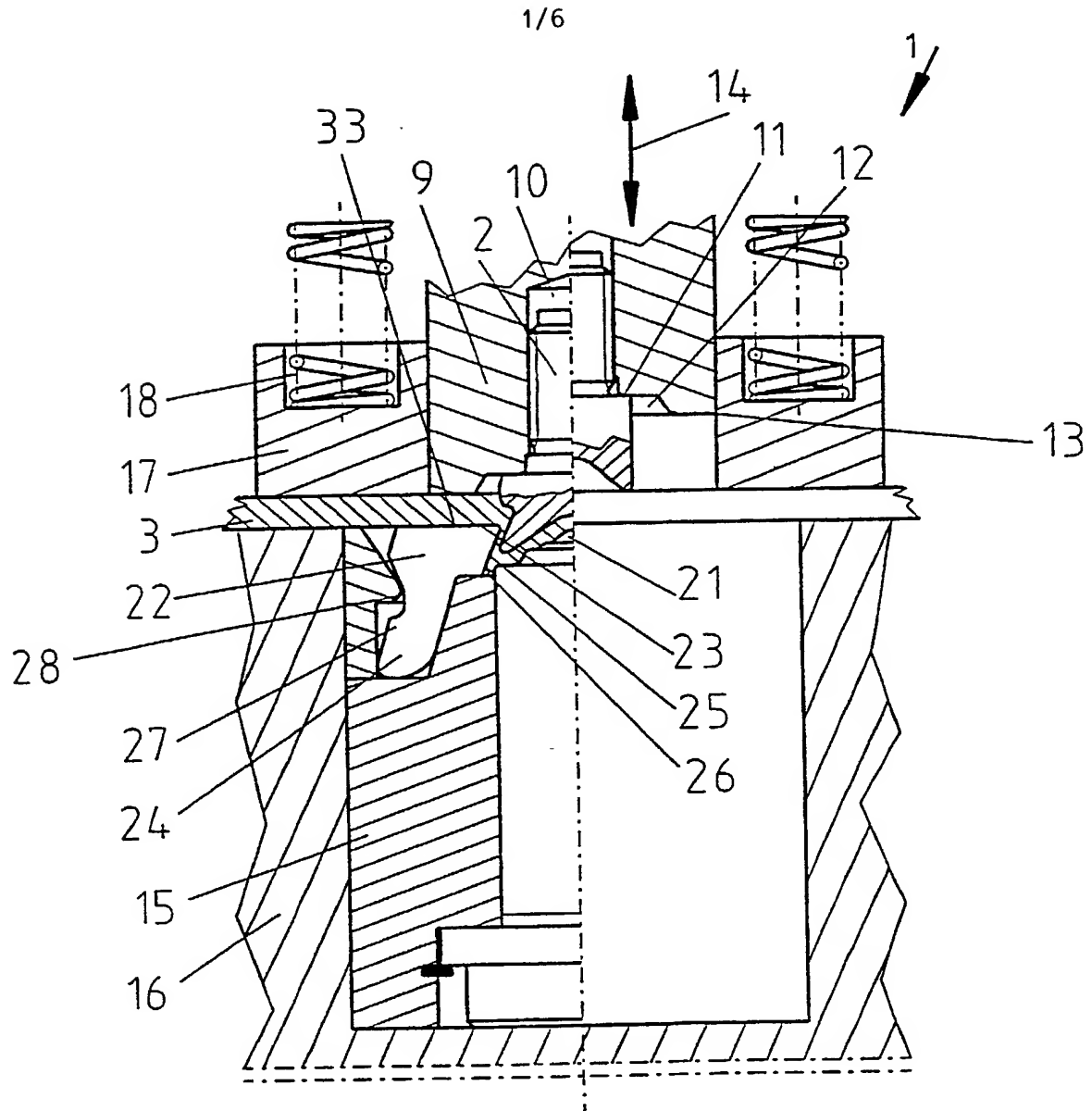
(54) Bezeichnung: VERFAHREN UND VORRICHTUNG ZUM BEFESTIGEN EINES HILFSFÜGETEILS AN EINEM
BLECHARTIGEN WERKSTÜCK UND WERKSTÜCK MIT HILFSFÜGETEIL

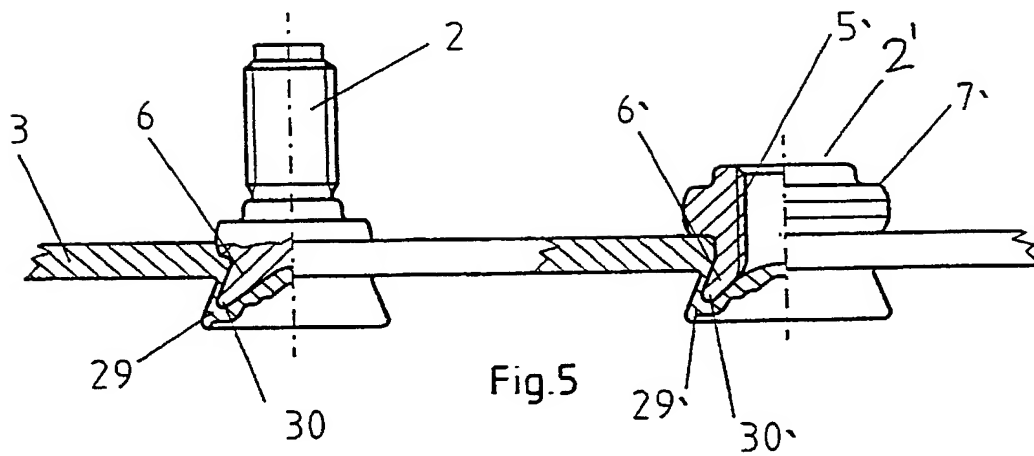
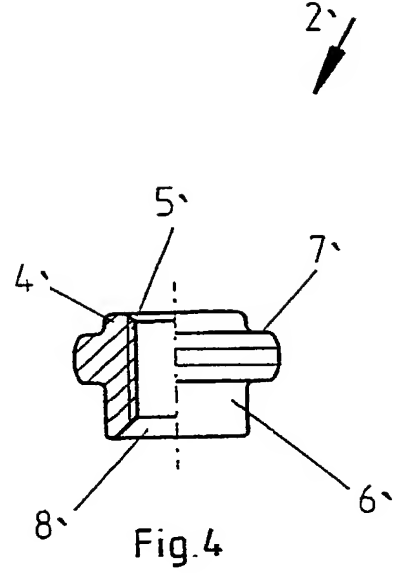
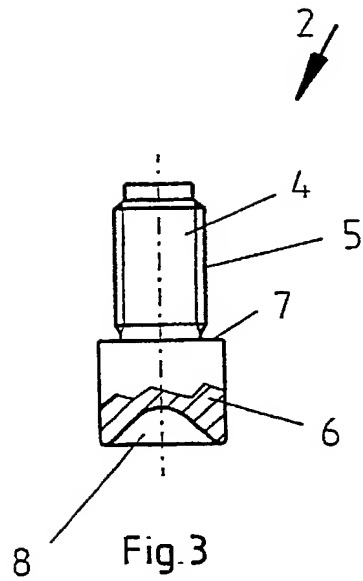


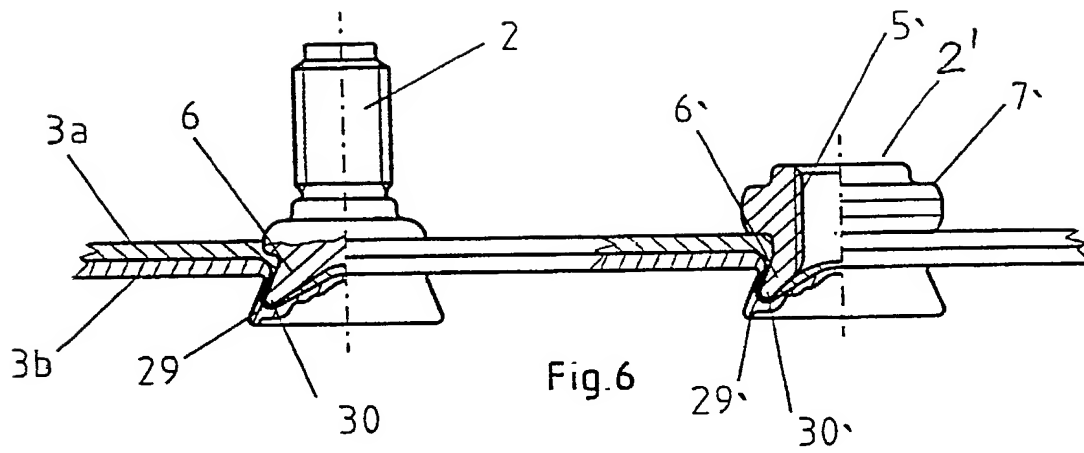
(57) Abstract: The invention relates to a method and a device for fastening an auxiliary joining element (2) to a sheet-shaped work piece (3). Said auxiliary joining element (2) is forced from one side into the work piece (3) with its base and deforms said work piece to a pot-shaped structure. The device is provided with a male mold (9) and a female mold (15) to deform the work piece. To this end, the base interacts with the work piece (3) to form an undercut, said undercut being limited to predetermined dimensions. The female mold is provided with a recess (19) with wall sections that are positioned on levers (22). Said levers (22) are displaced to a working position when pressure is applied in the direction of pressure (14). Said levers can be locked in the working position and form undercut sections (26). The levers are displaced to a release position when the unit consisting of the work piece (3) and the auxiliary joining element (2) is displaced opposite to the direction of pressure (14) to a release position, whereby the undercut sections (26) are completely released.

[Fortsetzung auf der nächsten Seite]

WO 00/71293 A1







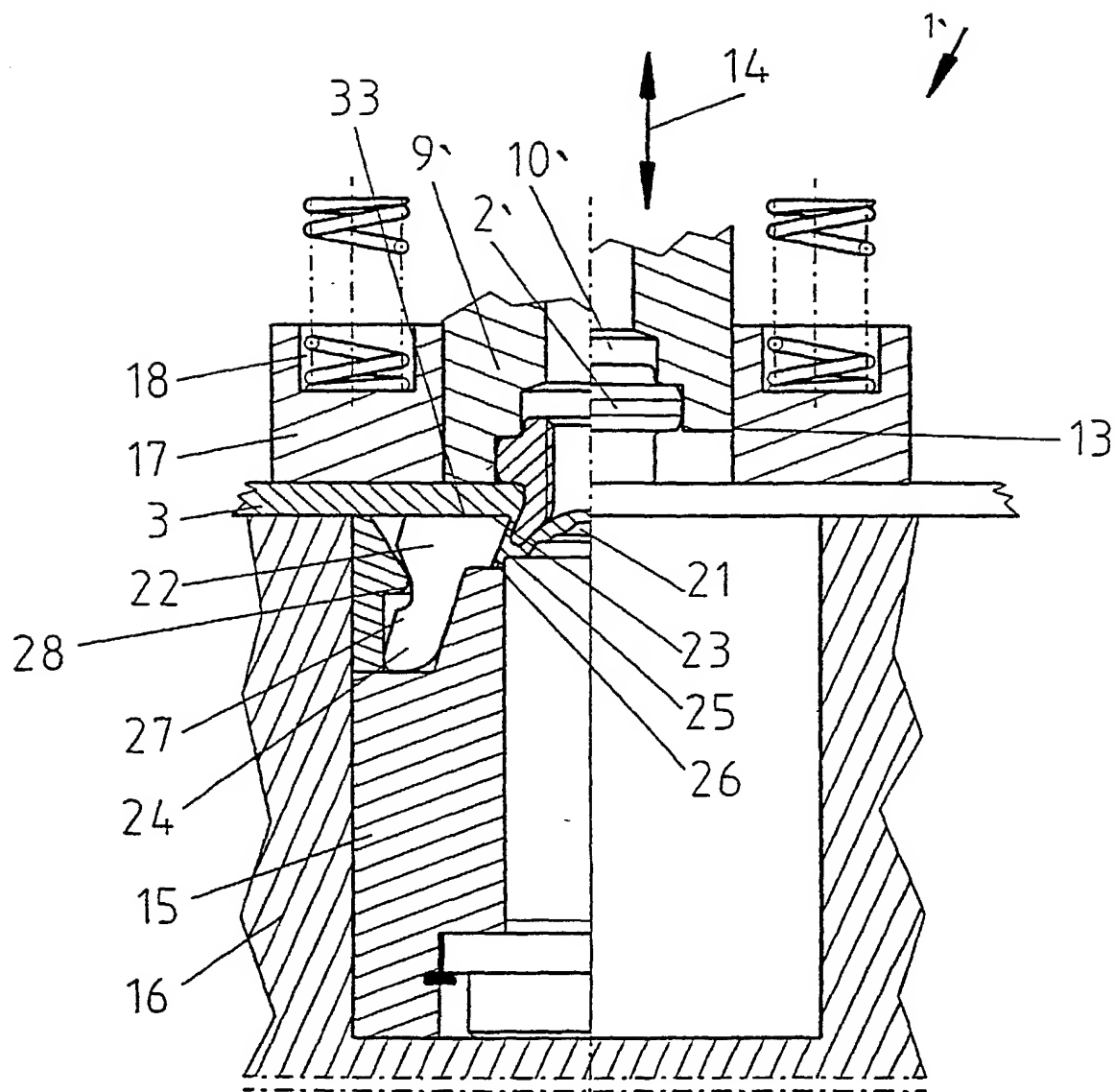


Fig. 7

5/6

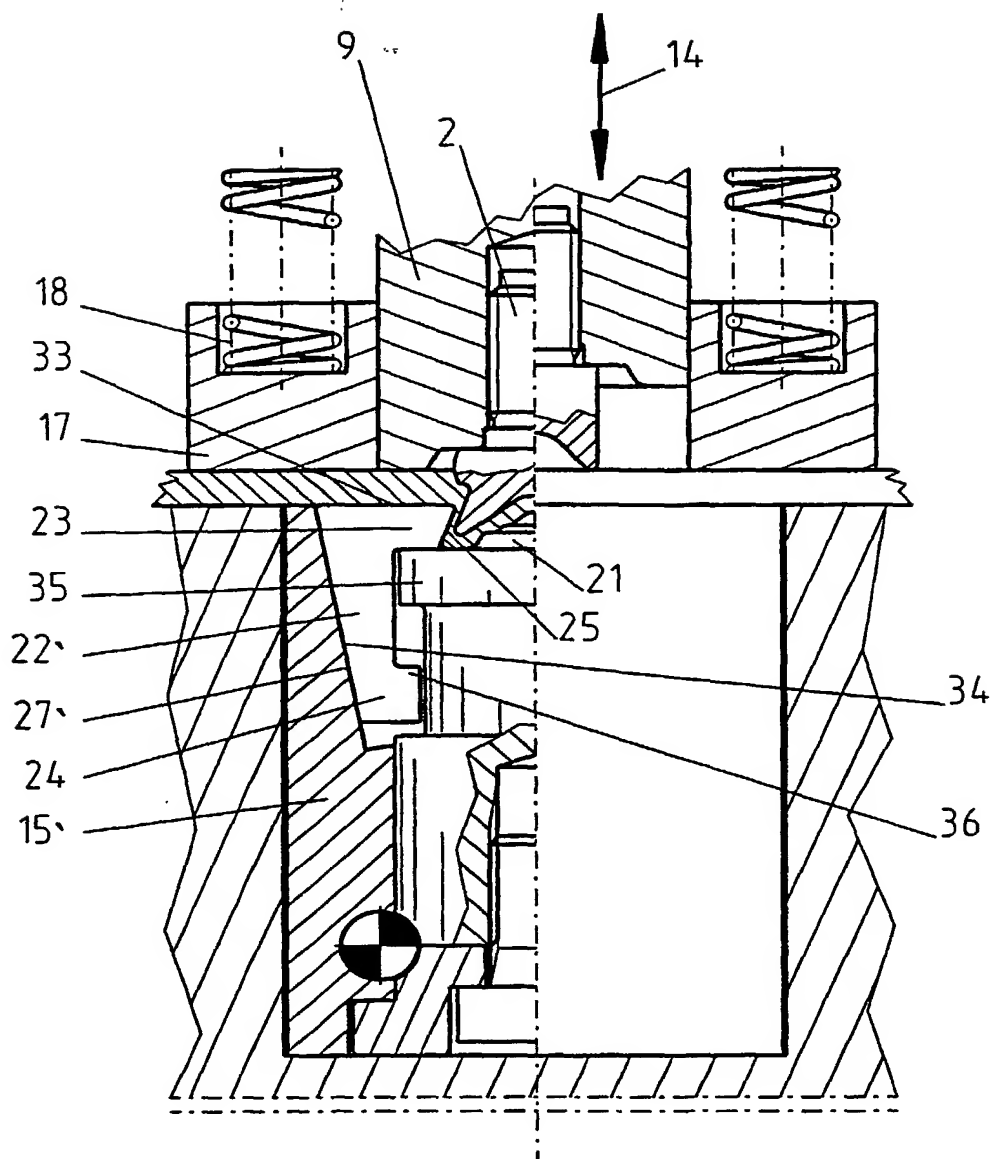


Fig. 8

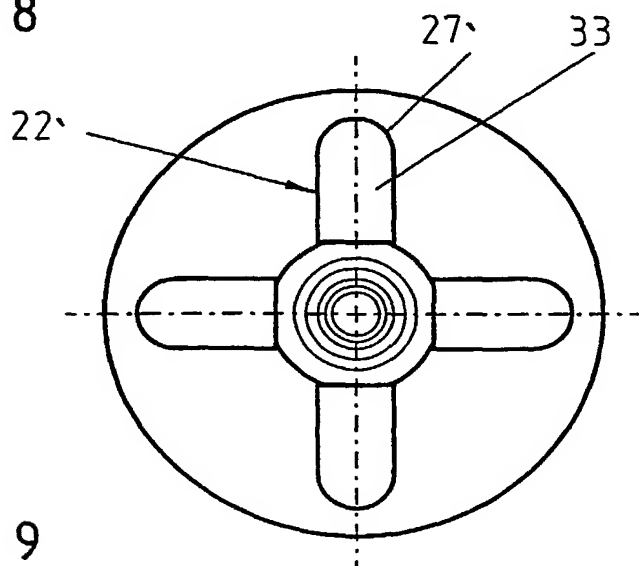


Fig. 9

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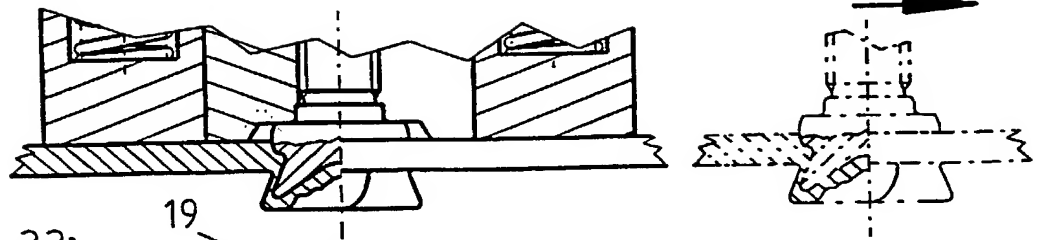


Fig. 10d

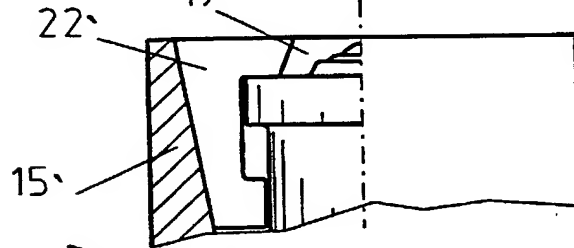


Fig. 10c

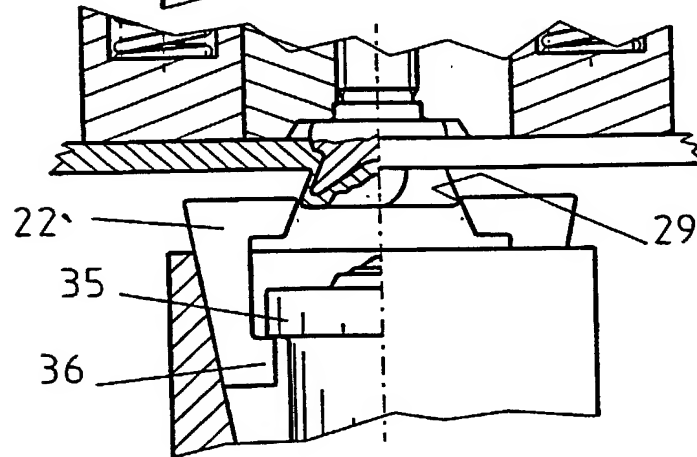


Fig. 10b

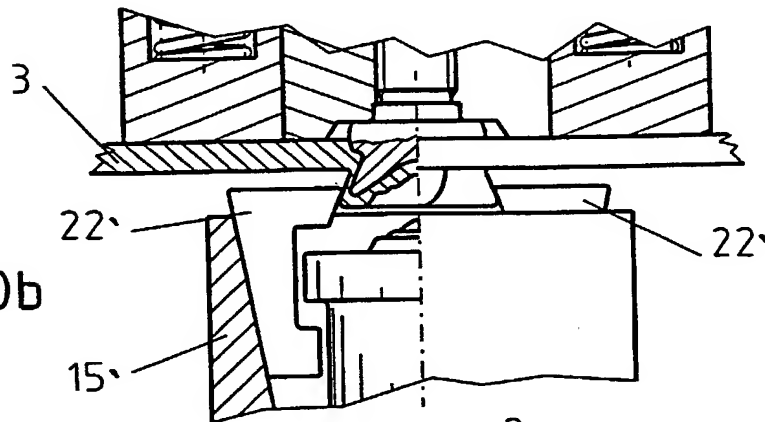
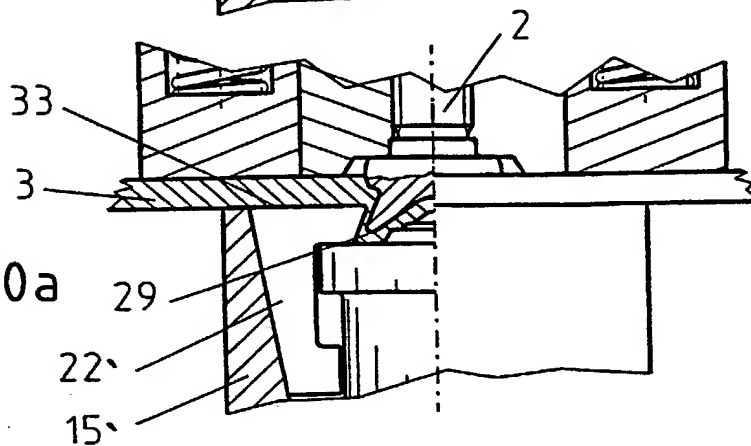


Fig. 10a



**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR UNITED STATES PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated near my name below.

I believe I am **the original, first and sole inventor** of the subject matter of which is claimed and for which a patent is sought on the invention entitled:

**METHOD AND DEVICE FOR FASTENING AN AUXILIARY JOINING ELEMENT
TO A SHEET-SHAPED WORK PIECE AND WORK PIECE THAT IS
PROVIDED WITH SUCH AN AUXILIARY JOINING ELEMENT**

which is described and claimed in the specification of which:

___ is executed on even date herewith; attorney docket number **docket no.**

 X was filed on **November 13, 2001** as United States Application Serial No. **10/031,655**, and amended by an amendment thereto submitted therewith (if any); attorney docket number **60,174-024** and that this application was filed on **May 10, 2000** as International Application (PCT) No. PCT/EP00/04153.

I declare that this application is:

 X a first filing.

___ a continuation.

___ a continuation-in-part.

___ a divisional.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I do not know and do not believe my invention was known or used by others in the United States of America, or patented or described in a printed publication in any country before my invention thereof.

I do not know and do not believe my invention was patented or described in a printed publication in any country or in public use or on sale in the United States of America, more than one year prior to this application.

I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim that no application for patent or inventor's certificate on this invention has been filed in any foreign country or in the United States of America prior to this application by me or my legal representatives or assigns except as follows:

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of the foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application(s) for patent or inventor's certificate filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

X no such applications have been filed.

___ such applications have been filed as follows:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (month, day, year)	PRIORITY CLAIMED UNDER 37 USC 119
Germany	PCT/EP00/04153	May 10, 2000	

I hereby claim priority to and all the benefits under Title 35, United States Code, §119(e) of any United States provisional application(s).

X no such applications have been filed.

___ such applications have been filed as follows:

APPLICATION NUMBER	DATE OF FILING (month, day, year)
-----------------------	--------------------------------------

I hereby claim priority to and all the benefits under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of the above identified application is not disclosed in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the filing date of this application.

X no such applications have been filed.

___ such applications have been filed as follows:

APPLICATION NUMBER	DATE OF FILING (month, day, year)	STATUS (patented, pending, abandoned)
-----------------------	--------------------------------------	--

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorneys and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith with full power of substitution and revocation. (all names listed with corresponding registration numbers)

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William H. Honaker	<u>31,623</u>	Jeffrey A. Sadowski	<u>29,005</u>
Raymond E. Scott	<u>22,981</u>	Randall L. Shoemaker	<u>43,118</u>
Gregory D. DeGrazia	<u>48,944</u>	Steven C. Wichmann	<u>37,758</u>
Samuel J. Haidle	<u>42,619</u>	James R. Yee	<u>34,460</u>
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DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

June 01, 2002
 Date

100

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